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(54) **Rolling bearing seal assembly with a built-in sensor**

Dichtungsanordnung für Rollenlager mit eingebautem Sensor

Dispositif d'étanchéité pour roulement à rouleaux avec capteur intégré

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Description

The present invention relates to a seal assembly with a built-in sensor, particularly for rolling bearings.

For protecting the rolling bodies of rolling bearings from external pollution, normally consisting of solid or liquid particles, seal assemblies are fitted between the bearing rings. These consist of one or more annular shields fitted integral with one of the bearing rings, and which provide for sliding seal action on the other bearing ring by means of respective elastomeric lips and/or for labyrinth sealing.

The rotation speed of the movable ring, and consequently of the shaft integral with it, is normally determined using a speed sensor comprising a Hall-effect or magnetoresistance sensor, and arranged facing a phonic wheel fitted directly on to the shaft.

The phonic wheel is made of ferromagnetic material, and presents a number of equally-spaced, magnetically nonuniform portions. Here and hereinafter, the term "magnetically nonuniform portions" is intended to mean element portions whose passage in a magnetic field results in a variation of the magnetic field at said portions, e.g. a number of solids and voids, or a number of projections formed on a surface facing the sensor. When the phonic wheel is rotated by the shaft, the alternating magnetically nonuniform portions moving past the sensor result in a variation in magnetic inductance, and in the generation by the magnetic sensor of a periodic signal. This is supplied to a central processing unit, which, on the basis of the frequency of the signal, provides for computing the number of revolutions per unit of time of the wheel and consequently of the shaft.

A major drawback of the above solution is that, for ensuring accurate speed detection, the phonic wheel and sensor must be mounted perfectly opposite each other, with a minimum amount of, as far as possible, constant tolerance.

A rolling bearing seal assembly according to the preamble of claim 1 is known from FR-A-2 660 975.

It is an object of the present invention to provide a rolling bearing seal assembly with a built-in sensor, designed to overcome the aforementioned drawback, and which provides for accurate, low-cost speed detection, whereby the seal assembly is also designed to house other types of sensors, in particular, a sensor for detecting the internal temperature of the bearing.

According to the present invention, there is provided a rolling bearing seal assembly with a built-in sensor as defined in claim 1.

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Fig.1 shows a partial section of a rolling bearing featuring a seal assembly in accordance with the present invention;

Fig.2 shows a detail of the Fig.1 seal assembly.

With reference to Fig.s 1 and 2, number 1 indicates a seal assembly with a built-in sensor 2, for a rolling bearing 3.

Bearing 3 comprises a first ring 4 rotatable in relation to a second ring 5; and a number of rolling bodies 6 interposed between rings 4 and 5, housed inside a chamber 8 defined between rings 4 and 5, and held in position by a retainer 7.

Seal assembly 1 comprises an annular shielding element 11 for closing chamber 8, and located opposite chamber 8 and outside bearing 3. Shielding element 11 presents a seat 12 housing sensor 2; and means 13 for connection to ring 5 and substantially consisting of an appendix 14 projecting from the inner side 15 of element 11 facing ring 5, and designed to click inside a corresponding annular groove 16 formed in inner wall 18 of ring 5. Groove 16 is so formed as to define a seat for a conventional type seal (not shown, by virtue of being replaced, in the example shown, by element 11).

As shown in Fig.1, outwards of sensor 2, seat 12 is closed by a cover element such as a plug 9.

Movable ring 4 is fitted integral with a second shielding element 21 made of ferromagnetic material and the lateral wall 22 of which, facing sensor 2, presents magnetically nonuniform portions 23 consisting of holes 24 formed in wall 22. Shielding element 21 presents a substantially sleeve type structure.

Sensor 2 in shielding element 11 consists of a magnetic sensor, preferably a Hall-effect or magnetoresistance type, and second shielding element 21 substantially constitutes a phonic wheel, so that elements 2 and 21 combine to define a rotation speed sensor.

As shown in Fig.2, shielding element 11 is so designed as to accommodate a number of seats 12, possibly of different shapes, and each housing a different type of sensor. Element 11 is fitted simultaneously with both sensor 2 and a known type of miniaturized temperature sensor 25 (not shown in detail) housed inside a second seat 12, offset angularly in relation to seat 12 of sensor 2, for continuously and accurately determining the temperature inside bearing 3. Fitment of a second sensor 2 (as shown by the dotted line) in a third seat 12, offset angularly by a given amount in relation to seat 12 of the first sensor 2, also provides for determining the rotation direction of ring 4 of bearing 3, by providing, in conjunction with element 21, two speed sensors in two different angular positions on element 11. Detection of the signal sequence of the two sensors 2 thus provides for determining not only the rotation speed but also the rotation direction of ring 4.

In actual use, sensor 2, connected to a measuring unit (not shown), is fitted inside one of seats 12 on element 11, and arranged facing shielding element 21 integral with movable ring 4 of bearing 3.

When ring 4 is rotated in relation to ring 5, the succession of magnetically nonuniform portions 23 moving past sensor 2 modifies the magnetic circuit represented substantially by sensor 2 and facing ferromagnetic ele-

ment 21, thus resulting in a variation in magnetic inductance and in the operating parameters of sensor 2.

The variation in the operating parameters of sensor 2 is recorded by a measuring unit (not shown), which provides for determining the number of such events per unit of time, and so determining the rotation speed of ring 4 in relation to ring 5.

The advantages of the present invention will be clear from the foregoing description. The manufacture of increasingly miniaturized sensors enables a number of sensors, arranged facing the rolling body chamber between the bearing rings, to be integrated in one seal formed according to the present invention and secured integral with the fixed bearing ring, the sensors being faced to the space provided between the rolling bodies and the rings. In the case of a speed sensor, the phonic wheel is housed directly inside the chamber itself, so that, in addition to constituting a passive component of the rotation speed measuring circuit, it also provides actively, in the form of a second seal, for protecting the rolling bodies interposed between the bearing rings.

Elimination of the conventional phonic wheel and integration of the sensors inside the sealing element also provide for simplifying and reducing the cost of assembly.

Claims

1. A rolling bearing seal assembly (1) with a built-in sensor (2), the rolling bearing (3) comprising a first ring (4) movable in relation to a second ring (5), and a number of rolling bodies (6) interposed between said first ring (4) and said second ring (5) and housed inside a chamber (8) defined between said first and second rings (4, 5);

   said seal assembly (1) comprising a first shielding element (11) for closing said chamber (8), said first shielding element being located opposite said chamber (8) and outside said bearing (3), and having means (13) for connection to said second ring (5) of said bearing (3) ; said connection means (13) including an annular appendix (14) projecting axially from a side of said first shielding element (11) facing said second ring, said appendix (14) being designed to be able to mate with a seat for a conventional type seal formed as a corresponding groove (16) in an inner wall of said second ring (5), said appendix (14) being snap-engaged with said groove (16);

   said seal assembly (1) further comprising a second shielding element (21) fitted integral with said first ring (4) of said bearing (3); said second shielding element (21) being made of ferromagnetic material and presenting magnetically nonuniform portions (23) formed on a lateral wall (22) thereof facing said first shielding element (11); and

   said assembly including at least two sensors (2 ; 25) housed inside said first shielding element, at least a first one (2) of said sensors (2 ; 25) being able to cooperate with said magnetically nonuniform portions (23) of said second shielding element (21);

   characterized in that

   - said magnetically nonuniform portions (23) consist of holes (24) formed in said wall (22);
   - said at least two sensors (2;25) are housed completely inside seats (12) formed inside said first shielding element (11);
   - at least a second one (25) of said sensors (2; 25) is a temperature sensor (25) for detecting the temperature inside said bearing, said temperature sensor (25) being housed in a second one of the seats (12) formed in said first shielding element (11), said second seat (12) being angularly offset in relation to the other seat(s) (12); and
   - faces of said at least two sensors (2;25) are arranged such that an external surface is flush with a surface of the first shielding element (11) directed toward said chamber (8).

2. A seal assembly (1) as claimed in Claim 1, characterized by the fact that a first of said sensors (2) in said first shielding element (11) consists of a magnetic sensor, while said second shielding element (21) constitutes a phonic wheel.

3. A seal assembly (1) as claimed in Claim 2, characterized by the fact that said magnetic sensor (2) is preferably a Hall-effect or magnetoresistance type sensor.

4. A seal assembly (1) as claimed in one of the foregoing Claims, characterized by the fact that said second shielding element (21) presents a substantially sleeve type structure.

5. A seal assembly (1) as claimed in anyone of the foregoing claims, characterized by the fact that it comprises at least two speed sensors (2) for determining the rotation direction of said movable ring (4) of said rolling bearing (3).

Patentansprüche

1. Dichtungsanordung (1) für ein Wälzlager (3) mit einem eingebauten Sensor (2), das einen ersten Ring (4), der in Bezug auf eine zweiten Ring (5) beweglich ist, und eine Anzahl Wälzkörper (6) aufweist,

die zwischen dem ersten Ring (4) und dem zweiten Ring (5) angeordnet und in einer Kammer (8) aufgenommen sind, die zwischen dem ersten und dem zweiten Ring (4, 5) ausgebildet ist, wobei

die Dichtungsanordnung (1) ein erstes Abschirmelement (11) zum Verschließen der Kammer (8) aufweist, das der Kammer (8) gegenüber außerhalb des Lagers (3) angeordnet ist und Mittel (13) zum Verbinden mit dem zweiten Ring (5) des Lagers (3) besitzt, die einen ringförmigen Fortsatz (14) einschließen, der axial von einer dem zweiten Ring (5) zugewandten Seite des ersten Abschirmelements (11) hervorsteht, so gestaltet ist, daß er mit einem Sitz für eine Dichtung herkömmlicher Art zusammen paßt, der als entsprechende Nut (16) in einer Innenwand des zweiten Rings (5) ausgebildet ist, und in die Nut (16) eingeschnappt ist,
die Dichtungsanordnung (1) ein zweites Abschirmelement (21) aufweist, das fest auf dem ersten Ring (4) des Lagers (3) sitzt, aus ferromagnetischem Material besteht und magnetisch ungleichförmige Abschnitte (23) besitzt, die an seiner Seitenwand (22) ausgebildet sind, die dem ersten Abschirmelement (11) zugewandt ist, und die Dichtungsanordnung (1) weiterhin wenigstens zwei Sensoren (2; 25) aufweist, die in dem ersten Abschirmelement (11) aufgenommen sind und von denen wenigstens ein erster Sensor (2) geeignet ist, mit den magnetisch ungleichförmigen Abschnitten (23) des zweiten Abschirmelements (21) zusammenzuwirken, **dadurch gekennzeichnet**, daß die magnetisch ungleichförmigen Abschnitte (23) aus Löchern (24) bestehen, die in Wand (22) ausgebildet sind,
die Sensoren (2; 25) vollständig in Sitzen (12) aufgenommen sind, die in dem ersten Abschirmelement (11) ausgeformt sind, wenigstens ein weiterer Sensor ein Temperatursensor (25) zum Erfassen der Temperatur innerhalb des Lagers (3) ist und in einem zweiten Sitz (12) aufgenommen ist, der in dem ersten Abschirmelement (11) ausgebildet und in Bezug auf den anderen Sitz (12) bzw. die anderen Sitze (12) winkelversetzt angeordnet ist, und
die Stirnseiten der Sensoren (2; 25) so angeordnet sind, daß ihre Außenflächen in Flucht mit einer zur Kammer (8) hin gerichteten Oberfläche des ersten Abschirmelements (11) liegen.

2. Dichtungsanordnung (1) nach Anspruch 1, **dadurch gekennzeichnet**, daß der erste Sensor (2) in dem ersten Abschirmelement (11) aus einem magnetischen Sensor besteht und das zweite Abschirmelement (21) ein phonisches Rad bildet.

3. Dichtungsanordnung (1) nach Anspruch 2, **dadurch gekennzeichnet**, daß der magnetische Sensor (2) vorzugsweise ein Hall-Effekt-Sensor oder ein magnetoresistiver Sensor ist.

4. Dichtungsanordnung (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß das zweite Abschirmelement (21) einen im wesentlichen hülsenartigen Aufbau besitzt.

5. Dichtungsanordnung (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß sie wenigstens zwei Geschwindigkeitssensoren (2) zur Bestimmung der Drehrichtung des beweglichen Rings (4) des Wälzlagers (3) besitzt.

Revendications

1. Ensemble d'étanchéité (1) pour roulement à rouleaux avec un capteur (2) intégré, le roulement à rouleaux (3) comprenant une première bague (4) mobile par rapport à une deuxième bague (5) et un certain nombre de corps roulants (6) interposés entre ladite première bague (4) et ladite deuxième bague (5) et logés dans une chambre (8) définie entre lesdites première et deuxième bagues (4, 5),

ledit ensemble d'étanchéité (1) comprenant un premier élément formant écran (11) servant à fermer ladite chambre (8), ledit premier élément formant écran étant situé en face de ladite chambre (8) et à l'extérieur dudit roulement (3), et comprenant un moyen (13) d'accouplement à ladite deuxième bague (5) du roulement, ledit moyen d'accouplement (13) comprenant un appendice annulaire (14) qui dépasse axialement d'un côté dudit premier élément formant écran (11) faisant face à ladite deuxième bague, ledit appendice (14) étant conçu pour pouvoir s'apparier avec un logement destiné à un joint d'étanchéité de type classique et se présentant sous la forme d'une rainure correspondante (16) formée dans la paroi intérieure de ladite deuxième bague (5), ledit appendice (14) étant encliqueté dans ladite rainure (16),
ledit ensemble d'étanchéité (1) comprenant en outre un deuxième élément formant écran (21) formé d'un seul tenant avec ladite première bague (4) dudit roulement (3), ledit deuxième élément formant écran (21) étant fait d'un matériau ferromagnétique et présentant des parties (23), non uniformes du point de vue magnétique, formées sur sa paroi latérale (22) faisant face audit premier élément formant écran (11), et
ledit ensemble comprenant au moins deux cap-

teurs (2, 25) logés dans ledit premier élément formant écran, un premier au moins (2) desdits capteurs (2, 25) étant capable de coopérer avec lesdites parties (23) non uniformes du point de vue magnétique dudit deuxième élément formant écran (21),

caractérisé par le fait que :

- lesdites parties (23) non uniformes du point de vue magnétique sont formées par des trous (24) percés dans ladite paroi (22),
- lesdits capteurs (2, 25) au nombre d'au moins deux sont totalement contenus dans lesdits logements (12) formés à l'intérieur dudit premier élément formant écran (11),
- un deuxième au moins (25) desdits capteurs (2, 25) est un capteur de température (25) servant à détecter la température à l'intérieur dudit roulement, ledit capteur de température (25) étant placé dans un deuxième desdits logements (12) formés dans ledit premier élément formant écran (11), ledit deuxième logement (12) étant décalé angulairement par rapport aux autres logements (12), et
- les faces desdits capteurs (2, 25) au nombre d'au moins deux sont disposées de telle sorte que leur surface extérieure est affleurante avec la surface du premier élément formant écran (11) tournée en direction de ladite chambre (8).

2. Ensemble d'étanchéité (1) selon la revendication 1, caractérisé par le fait qu'un premier (2) desdits capteurs dans ledit premier élément formant écran (11) est un capteur magnétique tandis que ledit deuxième élément formant écran (21) constitue une roue phonique.

3. Ensemble d'étanchéité (1) selon la revendication 2, caractérisé par le fait que ledit capteur magnétique (2) est de préférence un capteur à effet Hall ou de type magnétorésistif.

4. Ensemble d'étanchéité (1) selon l'une quelconque des précédentes revendications, caractérisé par le fait que ledit deuxième élément formant écran (21) a une structure sensiblement de type manchon.

5. Ensemble d'étanchéité (1) selon l'une quelconque des précédentes revendications, caractérisé par le fait qu'il comprend au moins deux capteurs de vitesse (2) pour déterminer le sens de rotation de ladite bague mobile (4) dudit roulement à rouleaux (3).

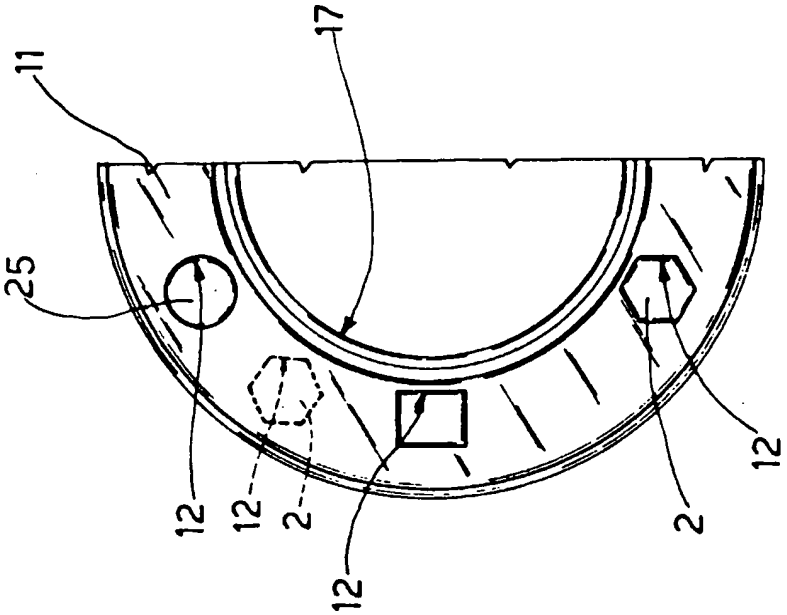

Fig.2

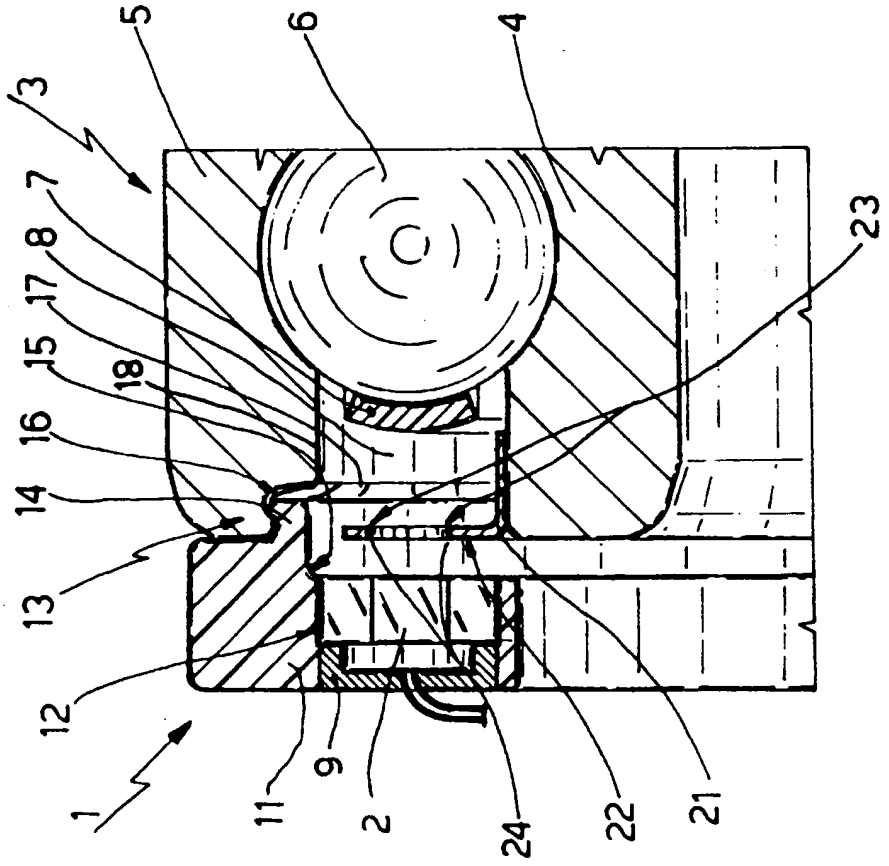

Fig.1